REMARKS

This Amendment is filed in response to the Office Action dated November 18, 2004. Accompanying this Amendment is a Petition for Extension of Time under 37 CFR 1.136(a) with proper fees, extending the period for response by three months, to February 18, 2005. Upon entry of this Amendment, claims 1 – 9, and 11 – 18 are pending in this application.

Independent claims 1 and 9 have been amended to more clearly point out and distinctively claim features of the present invention. Claim 4 has been amended to distinguish from amended Claim 1. Claims 5 and 7 have been amended to depend from Claim 1. Claim 10 has been cancelled. Support for the amendments can be found in the specification and drawings and in original claim 4. Applicant respectfully submits that no new matter is added by this Amendment.

The Examiner rejects Claims 1-18 under 35 U.S.C. §103(a) as allegedly unpatentable over Adler (USP 4,997,516), or Fakler et at. (USP 5,753,309) or Yoshizawa et. al. (USP 5,925,403). Applicant respectfully traverses this rejection and submits that the amended claims are patentable over the cited references.

The Examiner admits that none of the references teach reducing a copper oxide layer to form a copper layer on a substrate. Adler is directed to an improvement of surface treatment of copper surfaces where an oxidized copper surface is reduced in an alkaline solution. The Adler reference has nothing to do with atomic layer deposition of films on the surface of a substrate wherein a copper oxide layer is formed by alternatively reacting a surface of the substrate with a non-fluorine containing copper precursor and an oxygen contain gas, and then reducing the copper oxide layer by contacting the copper oxide layer with a hydrogen containing gas to form a copper layer on the substrate as recited in Applicant's amended claims.

Fakler also employs an aqueous reducing solution to reduce a copper oxide layer to metallic copper. Fakler teaches an aqueous reducing solution containing cyclic borane

compounds to reduce copper oxide on printed circuit boards to facilitate bonding a resin. Fakler does not teach or suggest the process recited in Applicant's amended claims.

Applicant respectfully submits that Yoshizawa adds nothing more. Yoshizawa is directed to a firing process to coat a ceramic film with copper. Yoshizawa employs a reducing solution to obtain copper particles. No where does Yoshizawa suggest an atomic layer deposition process for forming a copper film on the surface of a substrate as recited in Applicant's amended claims.

Applicant respectfully submits that it would not be obvious to arrive at the claimed invention given the teaching of the cited references. Applicant's invention is directed to a method of forming a copper layer on a substrate by atomic layer deposition (ALD). ALD is a complicated process requiring significant development and experimentation. The reduction of the copper oxide layer occurs in-situ, that is in the ALD chamber with gases as part of the deposition process. All three of these cited references use aqueous solutions in a subsequent and distinct processes. No where do the three cited references teach or suggest using hydrogen containing gas to reduce a copper oxide layer that has been formed by ALD on the surface of a substrate. The claimed invention is directed to a very different mechanism in an entirely different application.

The Examiner also notes Soininen (USP 6,482,740) as relevant art. Applicant respectfully submits that the claimed invention is patentable in light of Soininen.

Soininen is directed to a method of growing conductive layers. The Abstract states that in a preferred method a metal oxide thin film is deposited on a substrate surface and reduced thereafter essentially into a metallic form with an organic reducing agent. The reducing step is carried out using one or more vaporized organic compounds that contain at least one functional group selected from the group consisting of —OH, —CHO, and —COOH.

Soininen teaches at col. 11, lines 50-60 that surprisingly good adhesion of the reduced metal is preserved when using the specific organic reducing compounds, and that stronger reducing agents such as hydrogen plasma are undesirable. Soininen further teaches that that relatively bulky molecules (alcohols, aldehydes and carboxylic acids) are used as the reducing

agent, as they do not easily diffuse inside the metal oxide film and thus the reduction reaction takes place only at the surface of the metal oxide film, see col. 12, lines 8-13. Applicant respectfully submits that these statements teach away from Applicant's claimed invention which recites reducing the copper oxide layer by contacting with a hydrogen containing gas. Hydrogen is not a bulky molecule, and one would not be motivated to employ hydrogen to reduce the copper oxide layer given the teaching of Soininen.

Based on the above, Applicant respectfully submits that the application is in condition for allowance.

If any matters can be resolved by telephone, the Examiner is invited to call the undersigned agent at the telephone number listed below. The Commissioner is authorized to charge any additional required fees, or credit any overpayment, to Dorsey & Whitney LLP Deposit Account No. 50-2319 (Order No. A-71731/MSS (463035-861)).

Respectfully submitted,

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